Assessment of Climate Change for the Baltic Sea Basin - The BACC Project - 22-23 May 2006, Göteborg, Sweden

Climate-related Change in Marine Ecosystems

1) Background

Fig. 1: The Baltic Ice Lake (11700-11600 BP) (upper left), Yoldia Sea stage (11400-11300 BP, upper right), Ancylus Lake stage ca. 10300 BP (lower left), Littorina Sea stage ca. 7000 BP (lower right), created migration routes for Baltic Sea animals and plants.

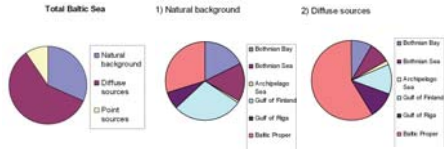

Fig. 2: Natural background, diffuse sources and atmospheric load (not shown here) of nitrogen add up, because they are subject to rain and runoff. Bothnian Bay and Sea, Gulfs of Finland and Riga run into Baltic Proper Belt Sea and Kattegat are not contributing to Baltic Proper eutrophication. Diffuse sources and the natural background make most of the total of yearly 680 542 t. The northern Baltic supplies most of the natural background loading, while the main source of diffuse loading is the Baltic Proper.

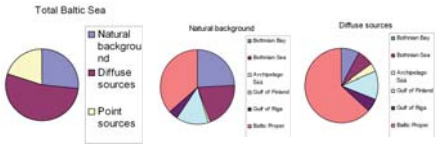

Fig. 3: Natural background of phosphorus loading is mostly from the northern parts, while diffuse sources predominate in the Baltic Proper.

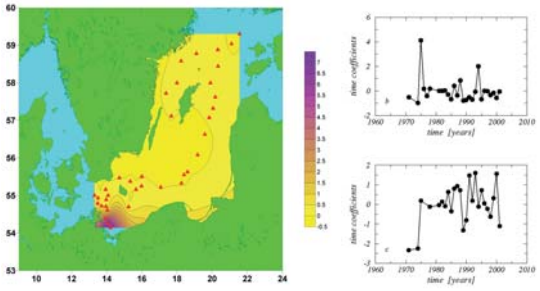

Fig. 4: Analysis of monitoring data show no trend in nitrogen concentration. First empirical orthogonal function (EOF) pattern of nitrate concentrations in the upper 30 m for winter, January and February average from HELCOM monitoring data (left). Stations are marked by triangles. Right: time coefficients of the 1st EOF pattern for nitrate concentrations (0-30m), for all stations in the Baltic Proper (upper panel), and for the stations in the Gotland Sea only (lower panel, after Voss et al. 2005).

The marine ecosystem was studied at all trophic levels, and time series of :

- Nutrients
- Contaminants
- Bacteria
- Phytoplankton
- Zooplankton
- Benthos
- Fish
- Marine mammals and
- Sea Birds

have been analysed for temporal changes and for possible relations with climatic factors.

Marine ecosystems are, among others, controlled by climatic factors

- Late quarternary development created migratory routes for biota from marine, freshwater, arctic and temperate environments. As a result, the Baltic Sea marine ecosystem includes a mixture of plants and animals that are of different origin, marine, freshwater, arctic, and temperate.
- The Baltic underwater ecosystem is ultimately driven by Major Baltic Inflows (MBIs) and the North Atlantic Oscillation (NAO), and the key factors is salinity, which regulates Baltic Sea plant and animal distribution, and diversity.
- MBIs, in turn, are controlled by climatic factors.
- Birds and other vertebrates are also controlled by weather and climatic factors, this is clearly seen in recent phenological changes.

Changes in salinity and nutrient concentrations are the primary factors affecting the marine ecosystem

- Higher winter temperature may prevent convection.
- Increasing wind speed deepens the thermocline.
- Increasing precipitation results in higher river runoff, nutrient input and eutrophication in the near coastal area.

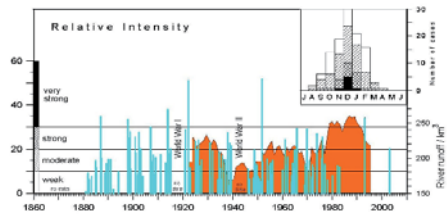

Fig. 5: Major baltic inflows (in blue) have became rarer since the 1980's, runoff (in orange) has increased during 1940 and 1980. Decreased salinity has caused large changes in the biota which are indicative of expected changes in the future.

Fig. 6: Modeled (top curve) and observed (lower curve) salinity changes in Baltic Sea deep water off Gotland at 200m depth. The response of the deep water salinity is related to the total freshwater runoff to the Baltic Sea (after Hänninen J., Vuorinen I., and Hjet P., 2000).

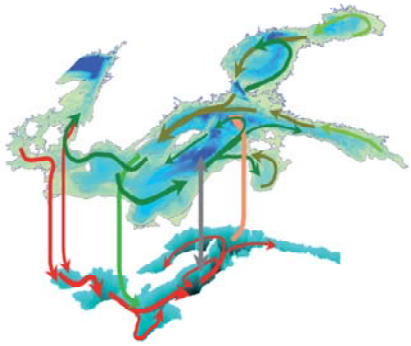

Fig. 7. Major current patterns in the Baltic Sea. Saline water is entering the Baltic Sea through the Danish Straits, while freshwater is supplied by numerous rivers.

Organised by: Göteborg University, GKSS, HELCOM

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